Correlated Oxides and Oxide Interfaces

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Conference Summary

Stimulating mix of
New materials,
New ideas
&
Experimental progress

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Correlated Oxides and Oxide Interfaces

Complexity requires synergy between

- Ab-initio electronic structure calculations
- Many-body model Hamiltonian approaches
- Materials
- Experiments

Designing new materials
& tuning electronic properties

-- bulk
-- interfaces
-- thin films
-- non-equilibrium

Chemistry
Structure
Geometry
Orbital engineering
Strain
Gating
Photo-control

Experimental Developments:

* Pump-Probe Expts. in correlated oxides

* Nonequilibrium dynamics:

eV pump → e-h pairs → t-resolved ARPES → el. spectral fn.
→ t-resolved optics → collective modes

* Photo-control of oxides

THz pump → resonant phonon mode
→ anharmonic couplings
→ induce electronic phase transitions

Experimental Developments:

Local Probes & Short-Range Order:

* Xray S(q) → Pair Distribution Fn.

-- persistence of local order well above phase transitions

-- relationship between local structure & electronic phases

* scanning charge detector -- nanotube SET

-- local imaging of ferroelastic domains in LAO/STO

5d Transition Metal Oxides:
Interplay of SOC & correlations

Iridates
SO Mott insulators Sr_2IrO_4
Hyper-honeycomb β-Li_2IrO_3,
Kitaev-Heisenberg Na2IrO3
Pyrochlores $A_2B_2O_7$

Osmates; Rhenates
Double perovskites $A_2BB'O_6$
Unusual exchange pathways

Tantalates
Surface of $KTaO_3$

Predictions for Topological states:

- Spin-liquids
- Weyl semimetals
- Chern insulators

- [111] films & surfaces of perovskites & pyrochlores

Interfaces & Heterostructures:

Emergence & tuning of New states at the interface between two known materials

- M-I transition and SC in STO

LAO/STO [band/band]

- Electrons at the interface: origin, density, itinerant/localized
- Transport; ferroelasticity; Superconductivity
- ferromagnetism

GTO/STO, SmTO/STO, NdTO/STO [Mott/band]

- M-I transition; ferromagnetism; Non-Fermi liquid behavior

LSMO/STO M-I transition

$CaMnO3/CaRuO_3$ $CaMnO_3/LaNiO_3$ [AF/PM] ferromagnetism

Thin Films

Nickelates

Ruthenates

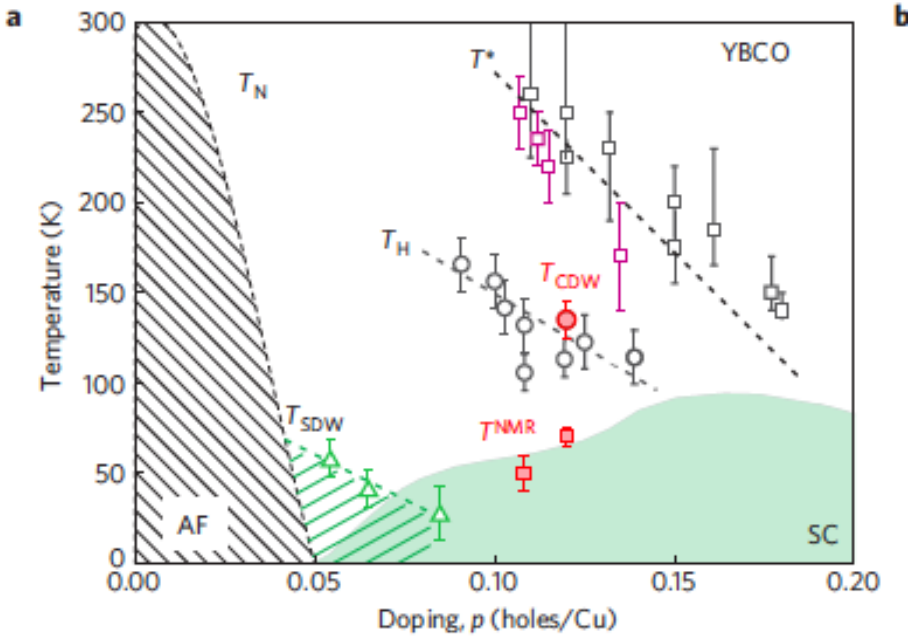
Thickness control; strain control
M-I transition; Lifshitz transition

Cobaltates

Cuprates

Gating with ionic liquids
SC-I transition
control doping without disorder

Cuprates:



Hard Xrays: Chang , Nature Phys. (2012)

soft xrays: Ghiringhelli. Science (2012)

Pseudogap in Underdoped Cuprates

loss of spectral wt.
at T* well abve Tc
(known for ~20-25 years)

* SC phase fluctuations in a small range of T above TC

* Competing order?

Recent progress: X-rays, NMR, Qtm Osc., STM, pump-probe, …

-- H=0: short-range CDW; SC ground state (YBCO,BSCCO,..)
-- high H: CDW LRO at low T; SC LRO destroyed (quantum oscl. YBCO,…)
-- STM, ARPES & Xray on Bi2212 & Bi2201
-- Is transport anomalous in PG state? No, in Hg 1201

Thanks to all of you
for making this such
an exciting workshop!